

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62300
	REVISION FINAL rev 5
SUBJECT: IN-PLACE HEPA FILTER TESTING	DATE 03/08/01
	PAGE 1 OF 9

Contents

- 1.0 Purpose/Scope**
- 2.0 Responsibilities**
- 3.0 Definitions**
- 4.0 Prerequisites**
- 5.0 Precautions**
- 6.0 Procedure**
- 7.0 References**
- 8.0 Attachments**
- 9.0 Documentation**

1.0 Purpose/Scope

This procedure provides methods for the in-place efficiency testing of HEPA filter systems at BNL.

High-efficiency particulate air (HEPA) filters are important components of many air pollution control systems. Due to their general reliability and high level of performance, these kinds of filters are commonly used in the nuclear field to minimize the release of radioactive particulate matter. HEPA filters are also used on laboratory fume hood and glove box systems, as well as in Class II biological safety cabinets (to remove potentially-infectious bioaerosols), and on special vacuum cleaner systems used for the collection of hazardous materials (e.g., asbestos debris).

At BNL, the majority of HEPA filters are found as integral components of laboratory fume hood systems used for operations involving radioactive materials. Other significant HEPA filter systems are found at the High-Flux Beam Reactor (HFBR), Brookhaven Medical Research Reactor (BMRR), and the Cold Neutron Facility (CNF). A small number of additional HEPA systems are present in the Inhalation Toxicology Facility (ITF).

HEPA filters are manufactured to remove $\geq 99.97\%$ of the particles with a mean diameter of 0.3 μm from an air stream. This specification is evaluated at a centralized DOE Filter Test Facility prior to release to end users such as BNL. Upon installation in the field, these filters must again be evaluated. This second phase of evaluation is known as “in-place” testing and is designed to

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62300
	REVISION FINAL rev 5
SUBJECT: IN-PLACE HEPA FILTER TESTING	DATE 03/08/01
	PAGE 2 OF 9

measure not only the particle removal efficiency of the HEPA filter but also of associated ductwork, gasketing, and the filter housing box. Criteria for the acceptance of an in-place test is a particle removal efficiency of $\geq 99.97\%$, unless the facility being tested has its own BNL approved performance specification as is the case at the HFBR and BMRR.

2.0 Responsibilities

This procedure will be implemented through the Industrial Hygiene Group Leader. At the present time, personnel from the Industrial Hygiene Group will continue to perform HEPA filter system testing and evaluation for BNL. Communication with, and cooperation from, Building Safety Services and Divisional Safety Coordinators will also be needed to coordinate this activity. Tests shall be performed by or under the direct supervision of persons who have demonstrated the competence to satisfactorily perform the tests as evidenced by experience and training.

3.0 Definitions

None.

4.0 Prerequisites

Prior to testing a HEPA filter system, verify the calibration and operability of the test equipment. Contact the appropriate Building Safety Services Representative or Technician to obtain approval and clearance to enter the test area. Ensure that the ventilation system is not in active use to avoid inadvertent contamination of equipment and exposure to personnel in the event of HEPA filter failure.

4.1 Hazard Determination:

- 4.1.1 The operation of this meter involves exposure to a low hazard chemical (test aerosol) that does not pose a high exposure risk. The meter design does not cause significant ergonomic concerns in routine use. The aerosol used in the generator would constitute Hazardous Waste if disposed on in bulk. The intended use of the aerosol as a test agent does not constitute a hazardous environmental emission.
- 4.1.2 By its very nature, a HEPA test may be done in areas where chemicals or radiation contamination is known or suspected to be present. Inhalation of these

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62300
	REVISION FINAL rev 5
SUBJECT: IN-PLACE HEPA FILTER TESTING	DATE 03/08/01
	PAGE 3 OF 9

contaminants can have significant health effects. These hazards must receive a hazard evaluation by a cognizant ESH professional.

4.2 **4.2 Personal Protective Equipment**

4.2.1 Hand: Contact with aerosol liquid should be minimized but does not pose a significant health risk. Use of this meter in areas of known or suspected chemical or radiological contamination requires the use of disposable gloves. Exam-style, splash gloves are acceptable. Acceptable elastomers are: Nitrile, PVC, and Natural Rubber.

4.2.2 Body:

4.2.2.1 If contact of the body with contaminated surfaces is anticipated, a disposable suit should be used. Acceptable CPC materials include: Tyvek®, KleenGuard®, and cotton. Disposable garments must be discarded as mercury waste if contact with contamination has occurred.

4.2.2.2 If contact with potentially contaminated surfaces is not expected, body covering is optional. However, if personal clothing items become contaminated, they must be surrendered for BNL cleaning or disposal.

4.2.3 Foot:

4.2.3.1 If contact of the feet is anticipated with contaminated surface, disposable shoe coverings, boots or booties should be used. Acceptable CPC material include: Tyvek®, KleenGuard®, and rubber.

4.2.3.2 If contact with potentially contaminated surfaces is not expected, shoe coverings are optional. However, if personal shoes become contaminated, they must be surrendered for BNL cleaning or disposal.

4.2.4 Respiratory: Under normal use, respiratory protection is not required. If chemical or radiological levels from contamination in the area exceed the OSHA, ACGIH, or DOE standards, respirators are required. A half face or full face APR or PAPR respirator with appropriate cartridge or an air line respirators may be used up to assigned protection factor listed in the BNL's Respiratory Protection Selection and Issuance SOPS.

4.2.5 Eye: Safety Glasses with side shields are required.

5.0 **Precautions**

Not applicable.

6.0 **Procedure**

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62300
	REVISION FINAL rev 5
SUBJECT: IN-PLACE HEPA FILTER TESTING	DATE 03/08/01
	PAGE 4 OF 9

- 6.1 Summary: Filter efficiency is determined by challenging a HEPA filter with an aerosol and measuring the aerosol concentration both upstream and downstream to calculate the percentage removed by the filter system.
- 6.2 Equipment: Emery 3004 or equivalent approved alternative
Aerosol generator
Aerosol detector
Sampling train (Tygon tubing and probes)
Source of clean, medium-pressure (e.g., 50-75 PSI) air
- 6.3 Identify the aerosol release and sampling point locations. The upstream filter sampling point should be at least 10 duct diameters from the aerosol release/system entry point to provide for a well-mixed suspension in the air mass. Similarly, the downstream sampling point should be located at least 10 duct diameters downstream from the filter housing. Where sampling points cannot be located at these distances due to the physical configuration of the ductwork, efforts should be made to maximize these distances to the greatest possible extent.
- 6.4 Activate the ventilation system or otherwise verify that the ventilation system is operating.
- 6.5 Inspect the HEPA filter system and its associated ductwork and mechanical components for any obvious signs of damage, e.g., missing or damaged seals, breached ductwork, excessive rust, unusually loud motor noise. Notify Plant Engineering and the Building Safety Services Representative of these conditions.
- 6.6 Attach sample collection tubing to detector and warm-up photometer in the “clear” mode until a stable baseline reading is obtained. Self-calibrate and zero the instrument according to manufacturer’s procedures. Insert sample probes into the duct centerline at both the upstream and downstream sampling points. For sampling locations with existing sampling ports or nozzles, attach sample lines as appropriate.
- 6.7 Assemble the aerosol generator system, i.e., ensure adequate supply of aerosol-producing medium, attach inlet regulator and gauge, and affix aerosol release nozzle. Insert generator nozzle into air stream, upstream of HEPA filter, at a point as described above. For laboratory hood systems, it is often most expedient to release the challenge aerosol directly into the fume hood. In this case, position the generator so that the nozzle protrudes at least 6 inches into the hood and lower all hood face sashes to the level

<p align="center">BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division</p> <p align="center">INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure</p>	<p>NUMBER IH62300</p>
	<p>REVISION FINAL rev 5</p>
	<p>DATE 03/08/01</p>
<p>SUBJECT:</p> <p align="center">IN-PLACE HEPA FILTER TESTING</p>	<p>PAGE 5 OF 9</p>

required to provide a minimum face velocity of 100 feet per minute.

Attach the compressed air supply line (from house air system or compressed gas cylinder) to the generator inlet regulator. Ensure that the generator regulator is open and deliver compressed air to the generator. The concentration of the challenge aerosol is a function of both the delivered air pressure and the volume of air exhausted through the ventilation system. For typical laboratory fume hood HEPA systems (e.g., air flows of about 1000-5000 ft³/min), the inlet regulator pressure should be adjusted to about 25 PSI. For significantly larger or smaller systems, the inlet pressure will need to be adjusted with the second state regulator to provide at least a four order-of-magnitude difference between upstream (challenge) and downstream concentrations. Note that manufacturer's specifications limit the maximum operating pressure for most generators to less than 100 PSI.

Inject aerosol into ventilation system until a stable measurement is obtained.

6.8 Measure upstream and downstream aerosol concentrations as follows:

- a. Record static pressure drop across filter(s) if a gauge is present
- b. Measure upstream aerosol concentration
- c. Return to "clear" mode and re-zero instrument if necessary
- d. Measure downstream aerosol concentration
- e. Return to "clear" mode and re-zero instrument if necessary
- f. Repeat steps b - e until sequential upstream and downstream readings are within
- g. Record upstream and downstream concentrations.

6.9 Calculate particle removal efficiency of the filter as follows:

$$\text{Removal Efficiency (\%)} = \frac{C_u - C_d}{C_u} \times 100$$

Where: C_d = downstream aerosol concentration
 C_u = upstream aerosol concentration

Record data and findings on test report form (see Attachment 8.4). With the exception of the HFBR and BMRR, where test acceptability varies as a function of other effluent treatment system criteria, acceptable in-place HEPA filter removal efficiency results are $\geq 99.97\%$. Affix results sticker at test location, fume hood face, or other appropriate

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62300
	REVISION FINAL rev 5
SUBJECT: IN-PLACE HEPA FILTER TESTING	DATE 03/08/01
	PAGE 6 OF 9

location.

- 6.10 HEPA filter systems shall be tested annually, or as required by other facility-specific specifications.
- 6.11 Record-keeping: A copy of the HEPA filter test report shall be provided to the Divisional Safety Coordinator, the Building Safety Services Representative, and any other interested parties. The original test report will be retained by S&EP in accordance with the record keeping requirements of SEP ADM-001.

7.0 References

- 7.1 American National Standards Institute (ANSI). Standard ANSI N510-current issue, Testing of Nuclear Air Treatment Systems.
- 7.2 BNL S&EP Procedures, IH-PP-8, HEPA Filter Surveillance Program.
- 7.3 American Conference of Governmental Industrial Hygienists (ACGIH). Industrial Ventilation: A Manual of Recommended Practice (current edition).
- 7.4 BNL Form BSS-1080. Laboratory Hood Surveys.

8.0 Attachments

- 8.1 HEPA filter system test results sticker
- 8.2 Sample BNL HEPA filter system test report (revised 10/27/00)

The only official copy is on-line at the SHSD IH Group website.
Before using a printed copy, verify that it is current by checking the document issue date on the website.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure		NUMBER IH62300
		REVISION FINAL rev 5
SUBJECT: IN-PLACE HEPA FILTER TESTING		DATE 03/08/01
		PAGE 7 OF 9

9.0 Documentation

Document Review Tracking Sheet		
PREPARED BY: R. Wilson Author Date 5/21/96	REVIEWED BY: G. Adams Group Leader Date 5/31/96	APPROVED BY: M. O'Brien OHS Section Head Date 6/11/96
Filing Code: IH52QR.01	E. Tucker DQAR Date 6/10/96	Effective Date: 06/15/96

Periodic Review Record (1 year cycle)		
Date of Review	Reviewer Signature and Date	Comments Attached
05/09/00	(signature/date on file) Robert Selvey 05/09/00	Technical Review completed. Compared to ANSI N510-R1995). No modifications needed.
07/07/00	(signature/date on file) Robert Selvey 07/07/00	Revised to SBMS format. Minor text changes made. Attachments 8.1, 8.2 and 8.3 deleted. Attachment 8.4 updated.
10/27/00	(signature/date on file) Robert Selvey 10/27/00	Revised Sample Form (Attachment 2) to facilitate data entry into new Microsoft Access database. Removed 07/07/00 strikeout markings. Re-numbered Attachments.
02/01/01	(signature/date on file) Robert Selvey 02/01/01	Revised Precautions section adding Hazard Assessment, PPE, and Waste.
03/08/01	(signature/date on file) Robert Selvey 03/08/01	Converted IH-FP-6.1 to new numbering system IH62300. Minor format changes.

The only official copy is on-line at the SHSD IH Group website.
Before using a printed copy, verify that it is current by checking the document issue date on the website.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62300
	REVISION FINAL rev 5
SUBJECT: IN-PLACE HEPA FILTER TESTING	DATE 03/08/01
	PAGE 8 OF 9

ATTACHMENT 8.1

HEPA Filter System Test Results Sticker/Label

In-Place HEPA Filter test			
Date	Effic. (%)	Pass/Fail?	Technician
Report any problem to: Safety & Health Services Division ext. 3900			

IH62300 ATTACHMENT 8.2

IN-PLACE HEPA FILTER TEST REPORT

BROOKHAVEN NATIONAL LABORATORY
Safety & Health Services Division
INDUSTRIAL HYGIENE GROUP

DATABASE RECORD ID#	SHSD UNIT ID#	
---------------------	---------------	--

DIVISION	BUILDING	ROOM/AREA
BLDG MANAGER	FS REPREP	OTHER CONTACT
SYSTEM DESCRIPTION		
SYSTEM TYPE <input type="checkbox"/> FIXED IN-PLACE <input type="checkbox"/> PORTABLE HANDLR	MANUFACTURER	FILTER NUMBER
SITE OF FILTER		

GENERATOR Nucon F1000-SN-10	GENERATOR SN 924SN1005392	AEROSOL Emery 3004
DETECTOR Nucon F1000-DDF	DETECTOR SN <input type="checkbox"/> 924DDF4592 <input type="checkbox"/> 822DDF106-97	
DETECTOR CALIB. DATE	COMMENTS	

TECHNICIAN R. D. Wilson	SIGNATURE	TEST DATE
-----------------------------------	-----------	-----------

Filter/Room Number	ΔP	Upstream Reading	Downstream Reading	Removal Efficiency ¹	Comments

¹Based upon formula:

$$\text{Removal Efficiency(\%)} = \frac{C_u - C_d}{C_u} \times 100$$

Where: C_d = downstream aerosol concentration
 C_u = upstream aerosol concentration

